PROVINCE OF ONTARIO

STANDARDS DEVELOPMENT BRANCH OMOE
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Presentation to the Air Pollution Control Board of the State of Indiana in Opposition to the Indiana - Kentucky Electric Generating Station Petition to Operate with An Increase in Its Sulphur Dioxide Emissions to 7.52 pounds of SO_2 per Million BTUs of Heat Input.

Indianapolis, Indiana
October 7, 1981

Ministry of the Environment
Hon. Keith C. Norton, Q.C., Minister
Gérard J. M. Raymond Deputy Minister

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INTRODUCTION

TRADITIONALLY CANADA AND THE UNITED STATES HAVE FUNCTIONED AS GOOD NEIGHBOURS IN A WAY WHICH IS HISTORICALLY UNIQUE. THAT RELATIONSHIP HAS ENABLED US TO WORK OUT MUTUAL PROBLEMS IN THE PAST. IT IS IN THE SPIRIT OF THAT CO-OPERATION THAT ONTARIO IS APPEARING HERE TODAY TO PUT FORWARD ITS POSITION, AND TO OFFER THE BENEFIT OF ITS EXPERIENCE AND KNOWLEDGE ABOUT THE ENVIRONMENTAL PROBLEM WE SHARE -- TRANSBOUNDARY AIR POLLUTION. THE TRANSBOUNDARY AIR POLLUTION PHENOMENON IS NOT GOVERNED BY ANY RESPECT FOR INTERSTATE BOUNDARIES, NOR INDEED FOR INTERNATIONAL ONES. PUT SIMPLY, WHAT GOES UP FROM ONE BACKYARD COMES DOWN IN ANOTHER.

THERE IS A GROWING BODY OF EVIDENCE TO SUPPORT THE VIEW THAT AIRSHEDS CAN NO LONGER BE CONSIDERED AS ENTITIES WITH LOCALIZED BOUNDARIES AND SUBJECT TO MANAGEMENT BASED ON LOCAL RATIONALES. IN THE CASE OF ATMOSPHERICALLY CONVEYED POLLUTANTS WE SHARE A COMMON AIRSHED. THUS, POLLUTION CONTROL TO PROTECT THE NORTH AMERICAN ENVIRONMENT MUST BE A SHARED RESPONSIBILITY AND COMMITMENT.

AS A RESULT, ONTARIO HAS AN INTEREST IN ANY HEARING THAT MIGHT INCREASE THE ATMOSPHERIC LOADING OF SO_2 TO THIS COMMON AIRSHED, IN THIS CASE, THE PETITION AND APPLICATION FOR OPERATION PERMIT WITH SULPHUR DIOXIDE EMISSION LIMITATION OF

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7.52 POUNDS OF SO_2 PER MILLION BTUS OF HEAT INPUT SUBMITTED BY THE INDIANA-KENTUCKY CLIFTY CREEK GENERATING STATION IN JEFFERSON COUNTY, INDIANA.

ONE NEEDS ONLY TO CONSIDER THE DAMAGE ALREADY DONE TO ONTARIO'S RECREATIONAL AREAS WHICH ARE SENSITIVE TO ATMOSPHERIC POLLUTANTS. IF CONTINUED DEGRADATION IS TO BE PREVENTED AND FUTURE DAMAGE AVERTED, THEN A REDUCTION OF EMISSIONS IS NEEDED ON AN EASTERN NORTH AMERICAN BASIS AND ANY INCREASES IN EMISSIONS, TAKEN SINGLY OR COLLECTIVELY, CAN ONLY SERVE TO AGGRAVATE THIS SITUATION.

THEREFORE, ONTARIO'S POSITION AT THIS HEARING AND ANY SIMILAR ONE IS TO OBJECT TO ANY INCREASE IN SO_2 EMISSIONS. FOR ONTARIO BELIEVES THAT THE ULTIMATE SOLUTION TO THE PROBLEM INVOLVES A REDUCTION IN EMISSIONS BY ALL SIGNIFICANT SOURCES. TAKEN AGGREGATIVELY, THESE REDUCTIONS WILL LESSEN THE ATMOSPHERIC BURDEN OF ACID FORMING SUBSTANCES WHICH IS A PREREQUISITE FOR PROTECTING ONTARIO'S SENSITIVE AND VERY VALUABLE ENVIRONMENT.

IN SEARCH OF A SOLUTION TO THIS PROBLEM, CANADA AND THE UNITED STATES SIGNED A MEMORANDUM OF INTENT ON TRANSBOUNDARY AIR POLLUTION ON AUGUST 5, 1980 WHICH COMMITTED BOTH NATIONS TO RESIST EMISSION INCREASES AND TO BRING ABOUT REDUCTIONS WHERE POSSIBLE PENDING CONCLUSION OF A COMPREHENSIVE INTERNATIONAL AGREEMENT.

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Under this document, both the U.S. and Canada undertook to take certain interim actions. These included the development of air pollution control strategies and the vigorous enforcement of existing laws and regulations "in a way which is responsive to the problems of transboundary air pollution".

Legal And Policy Considerations

Ontario is subject to acid deposition which, as we will subsequently illustrate, is already resulting in harmful effects on Ontario's lakes and aquatic life. There is evidence that power plants in the midwestern United States significantly contribute to acid deposition in Ontario. The State of New York has identified 20 fossil fuel-fired generating stations in six States which are in the process of seeking a relaxation in emissions as set out originally by the States in their State Implementation Plans. These power plants are identified and data about their emissions of SO_2 is given in the Submission of the Province of Ontario to the Environmental Protection Agency dated March 12, 1981, expanded March 27, 1981, filed with you. The Clifty Creek Power Plant is one of these 20 plants. It is among the largest of the plants and is one of the largest contributors to the total loading of SO_2 in the atmosphere (Table 2.5, page 17).

These 20 plants, among others, contribute to emissions of SO_2 which are precursors to acid rain in Ontario. As the Province of Ontario has demonstrated in previous submissions

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TO THE E.P.A., THERE IS EVIDENCE THAT THE SAME EMISSIONS THAT HAVE AN IMPACT ON THE STATE OF NEW YORK ALSO HAVE AN IMPACT ON THE PROVINCE OF ONTARIO. THIS GIVES THE PROVINCE OF ONTARIO A SIGNIFICANT INTEREST IN THE OUTCOME OF ANY PROCEEDINGS THAT MAY LEAD TO INCREASES IN ALLOWABLE SULPHUR DIOXIDE EMISSIONS FROM ANY OF THESE POWER PLANTS. ONTARIO BELIEVES THAT RIGHTS CONFERRED BY ACCORDS, BY PRINCIPLES OF INTERNATIONAL LAW, AND BY SECTION 115 OF THE CLEAN AIR ACT GIVE THE PROVINCE NOT ONLY A SIGNIFICANT INTEREST IN THE OUTCOME OF SUCH PROCEEDINGS, BUT ALSO A RIGHT TO ADVANCE NOTIFICATION AND CONSULTATION ON PROPOSED ACTIONS INVOLVING A SIGNIFICANT RISK OR A POTENTIAL RISK OF CAUSING OR INCREASING TRANSBOUNDARY AIR POLLUTION, AND A RIGHT TO BE FREE FROM HARM TO ITS ENVIRONMENT CAUSED BY ACTIVITIES IN THE TERRITORY OF ANOTHER COUNTRY.

ONTARIO THEREFORE APPEARS BEFORE YOU TO URGE THAT NO SIP REVISION BE ALLOWED WHICH WOULD LEAD TO INCREASED SO_2 EMISSIONS FROM THE CLIFTY CREEK POWER PLANT.

AT THIS TIME, I DO NOT PROPOSE TO REVIEW IN DETAIL THE LEGAL PROPOSITIONS ALREADY FILED WITH YOU. HOWEVER, I WOULD LIKE TO HIGHLIGHT CERTAIN ASPECTS OF THEM. FIRST, ONTARIO RELIES ON WELL-ESTABLISHED PRINCIPLES OF INTERNATIONAL LAW IN SUGGESTING THAT THE STATE OF INDIANA HAS A DUTY NOT TO PERMIT ACTIVITIES THAT WILL IMPAIR THE ENVIRONMENT IN CANADA. THE TRAIL SMELTER CASE, REFERRED TO IN THE SUBMISSION FILED WITH YOU ON PAGE 32, ESTABLISHES THE FOLLOWING FUNDAMENTAL PRINCIPLE:

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> "A State owes at all times a duty to protect other States against injurious acts by individuals from within its jurisdiction . . . International decisions, in various matters, . . . are based on the same general principle, . . .".

The principle was also stated in the following language:

> ". . . under the principles of international law, as well as the law of the United States, no State has the right to use or permit the use of its territory in such manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence".

It does not matter that the Clifty Creek Power Plant is only one of many power plants whose emissions significantly contribute to the atmospheric pollutant burden which is detrimentally affecting Ontario's environment. The fact that no single source of emissions may by itself be a major contributor to acid deposition in Ontario does not excuse any failure to deal with each source individually. When confronted with harm caused by pollution from many sources, where there is difficulty in segregating and measuring the impacts of individual sources, the courts have still been able to design effective remedies by applying traditional tort principles. For example, the Supreme Court of the United States has recognized traditional principles of tort law in the context of inter-state air or water pollution. The Court has fashioned a federal common law of nuisance.

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Thus, the Supreme Court has implicitly adopted the principle of tort law that where there are many sources of contamination, each may be liable for its portion of the damage caused cumulatively by all of them. It is no defence that others are also contributing to the damage. (Illinois v. Milwaukee, 406 U.S. 91 (1972)). The fact that each contributor may be jointly and severally liable for damage has also been recognized by other U.S. courts. (Michie v. Great Lakes Steel, 495F.2d 213, 4 ELR 20324 (6 Circuit 1974), Cert. denied 419 US 997,95S.Cp.310 (1974)) The state of Indiana should apply the same reasoning to its decision in this case.

Secondly, Ontario wishes to draw to the attention of the Indiana Pollution Control Board the Memorandum of Intent concerning transboundary air pollution entered into on August 5, 1980 by the Government of Canada and the Government of the United States. In this document, the parties declared their intention "to develop a bilateral agreement which will reflect and further the development of effective domestic control programs and other measures to combat transboundary air pollution".

Both parties undertook to take certain interim actions pending conclusion of such an agreement. These interim actions included the following undertakings with respect to control measures.

> "To combat trans-boundary air pollution both Governments shall:
>
> (a) Develop domestic air pollution control policies and strategies as necessary and appropriate, seek legislative or other support to give effect to them;

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(b) Promote vigorous enforcement of existing laws and regulations as they require limitation of emissions from new, substantially modified and existing facilities in a way which is responsive to the problems of transboundary air pollution; and

(c) Share information and consult on actions being taken pursuant to (a) and (b)."

Ontario urges the IPCB to take account of the above undertakings and to make its decision with respect to this proposed SIP revision in a matter consistent with such undertakings.

With regard to the goal shared by both governments of promoting the vigorous enforcement of existing laws and regulations, Ontario would like to point out that the Clifty Creek Power Plant has been in contravention of existing or proposed emissions standards for some time. There have been several standards proposed or promulgated. At various times, there has been a 1.2 lb SO_2/M BTU SIP standard, the validity of which is under review by the Courts, a 4.19 standard proposed by the E.P.A., and a State standard of 6.0. Ontario understands that the 6.0 limit is the one which the State of Indiana considers to be under review in these Hearings. The emissions from the Clifty Creek Power Plant at 6.85 lbs. of SO_2 per million BTU do not even comply with this 6.0 limit. To raise the permissible limit to make otherwise unlawful emissions lawful, rather than enforce the

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existing law, Ontario submits would be contrary to the spirit of the Memorandum of Intent. We urge that pending the finalization of an international agreement on transboundary pollution, the State of Indiana should use its best efforts to make the Clifty Creek Power Plant comply with present limits rather than raise those limits.

Ontario is aware that Section 115 of the Clean Air Act provides a mechanism for considering the cumulative effects of emissions from many sources on transboundary pollution. Ontario is investigating what remedies it may have under this Section. However, Ontario submits that it is fruitless to deal with the cumulative effects of many sources without also considering the international implications of raising SIP limits on individual plants. The whole is, after all, the sum of its parts. It makes little sense to approve SO_2 relaxations now which may conflict with the results of Section 115 proceedings which have already been initiated or may be initiated in the future. Therefore, Ontario urges the State of Indiana to refuse any relaxation of the SIP in the instant case.

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BACKGROUND INFORMATION

HISTORICALLY, ENVIRONMENT ONTARIO AND OTHER NORTH AMERICAN JURISDICTIONS HAVE BEEN DEALING WITH CONTAMINANTS AS POLLUTANTS IN THEIR OWN RIGHT, CONCERNED WITH THEIR POTENTIAL "LOCALIZED" AND "COMMUNITY EFFECTS".

TO AID IN THIS ACTIVITY, THE ONTARIO ENVIRONMENT MINISTRY ESTABLISHED A PROVINCE-WIDE INVENTORY OF AIR CONTAMINANTS IN 1972, WHICH INCLUDES SULPHUR DIOXIDE. CONCENTRATIONS OF 30 KNOWN AIR-BORNE CONTAMINANTS ARE MEASURED BY A MONITORING NETWORK DISTRIBUTED THROUGHOUT ONTARIO WHICH CONSISTS OF MORE THAN 1,400 AIR QUALITY INSTRUMENTS, SOME OF WHICH ARE OPERATED ON A SPECIAL STUDY BASIS. THIS MONITORING NETWORK WAS ESTABLISHED TO OBTAIN COMPREHENSIVE KNOWLEDGE OF THE AIR QUALITY IN ONTARIO. THE DATA HAS BEEN RELATED TO EMITTING SOURCES AND, IN ASSOCIATION WITH AIR QUALITY SIMULATION MODELS, HAS BEEN USED TO DEVELOP CONTROL STRATEGIES FOR THESE SOURCES WHEN AIR QUALITY CRITERIA SET BY THE PROVINCE WERE EXCEEDED.

HOWEVER, STUDIES OF GENERATION AND TRANSPORT OF TOTAL SUSPENDED PARTICULATES AND THE PHOTOCHEMICAL PRODUCT, OZONE, HAVE INDICATED THAT A LARGE CONTRIBUTION WAS ATTRIBUTABLE TO OUT-OF-THE PROVINCE SOURCES. MORE RECENTLY, ACIDIC PRECIPITATION STUDIES HAVE DEMONSTRATED THAT THE PRECURSORS, SO_2, SULPHATES, AND NITRATES ARE DUE TO SOURCES WHICH ARE IN PART VERY DISTANT FROM THE SENSITIVE RECEPTOR LAKES. THE SEVERITY OF THIS PROBLEM OF LONG RANGE TRANSPORT IN ONTARIO

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BECAME APPARENT WHEN ONTARIO SCIENTISTS BEGAN TO ANALYSE THE RESULTS FROM SEVERAL SPECIAL STUDIES, IN PARTICULAR, THE SUDBURY ENVIRONMENTAL AND LAKESHORE CAPACITY STUDIES. BOTH OF THESE GEOGRAPHICALLY INTENSIVE PROGRAMS MEASURED ATMOSPHERIC POLLUTANTS AND QUANTIFIED THE PROPORTION WHICH, AS A CONSEQUENCE OF VARIOUS PHYSICAL AND CHEMICAL MEANS, ULTIMATELY END UP IN SENSITIVE TERRESTRIAL AND AQUATIC ECOSYSTEMS.

IN PARTICULAR, THESE STUDIES INDICATED THAT WHEN USING CONTEMPORARY MONITORING AND ANALYTICAL TECHNIQUES, THE SECONDARY OR EVOLUTIONARY POLLUTANTS ASSOCIATED WITH PRIMARY EMISSIONS OF PARTICULATES AND SO_2 WERE BEING DEPOSITED IN LARGE MEASURE BY THE RAIN FALLING OVER LARGE PORTIONS OF THE PROVINCE. FURTHERMORE, THIS POLLUTED RAIN WAS AND IS SERIOUSLY AFFECTING ONTARIO'S VERY SENSITIVE ENVIRONMENT.

IN RESPONSE TO THE SERIOUSNESS OF THIS SITUATION AND RECOGNIZING ITS SIMILARITY WITH THE SCANDINAVIAN PROBLEM, THE ONTARIO GOVERNMENT INITIATED A MAJOR LONG RANGE TRANSPORT OF ATMOSPHERIC POLLUTANTS OR "ACIDIC PRECIPITATION" PROGRAM IN 1979. CURRENTLY THIS PROGRAM HAS A BUDGET IN EXCESS OF SIX MILLION DOLLARS PER YEAR WHICH IS OF THE ORDER OF $1.00 PER CAPITA PER YEAR.

THE MAJOR ELEMENTS OF THIS EFFORT INCLUDE THE FOLLOWING UNDERTAKEN IN PARALLEL:

1. A SCIENTIFIC LRTAP/ACID RAIN ASSESSMENT PROGRAM;

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2. SOCIO-ECONOMIC INITIATIVES;

3. CONTROL TECHNOLOGY INVESTIGATIONS;

4. INFORMATION DISSEMINATION AND PUBLIC EDUCATION PROGRAM;

5. POLICY EVALUATION, RECOMMENDATION AND IMPLEMENTATION.

THE REALITY OF THE LRTAP PHENOMENON

THE RECOGNITION THAT AIR POLLUTANTS CAN BE TRANSPORTED FAR BEYOND THEIR LOCAL ORIGINS IS NOT NEW. ONE OF THE EARLIEST REFERENCES TO THE EXISTENCE OF A LONG RANGE TRANSPORT PHENOMENON OCCURRED IN THE MID 19TH CENTURY. THE FREQUENCY OF SUCH REFERENCES HAS INCREASED OVER THE PAST ONE HUNDRED YEARS.

HOWEVER, ACTUAL SCIENTIFIC INVESTIGATIONS OF THE VARIOUS ASPECTS OF THIS PROBLEM HAVE ONLY BEEN INCREASING OVER THE PAST 15 TO 20 YEARS. THE FUNDAMENTAL FINDINGS OF THIS RESEARCH HAVE ESTABLISHED THAT A NUMBER OF PRIMARY AND SECONDARY AIR POLLUTANTS, INCLUDING PARTICULATES, CARBON MONOXIDE, OZONE, SULPHATES, NITRATES AND VARIOUS ORGANIC COMPOUNDS CAN UNDERGO LONG RANGE TRANSPORT, I.E. HUNDREDS OF KILOMETRES. IN FACT LONG RANGE TRANSPORT HAS NOT ONLY BEEN DOCUMENTED ON A REGIONAL SCALE (100 - 300 KM), BUT ALSO ON THE CONTINENTAL (500 - 1000 KM) AND EVEN THE HEMISPHERIC OR GLOBAL (1000 TO 5000 KM) SCALES. HOWEVER, DUE TO THE

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AVAILABILITY OF CONSIDERABLY MORE DATA ON THE REGIONAL AND CONTINENTAL SCALES, OBSERVATIONS CAN BE MADE TO LINK SUCH TRANSPORT TO VISIBILITY DEGRADATION, AQUATIC AND TERRESTRIAL IMPACTS, MATERIALS DAMAGE, ETC.

IN THE LAST 10 YEARS, INTENSIVE FIELD INVESTIGATIONS HAVE BEEN INITIATED IN BOTH EUROPE AND NORTH AMERICA. THESE STUDIES HAVE CENTERED ON INCREASING THE UNDERSTANDING OF THE CYCLES AND BUDGETS OF SULPHUR POLLUTION. THE VARIOUS COMPONENTS OF THESE STUDIES HAVE INCLUDED CHARACTERIZATION AND DEVELOPMENT OF EMISSION INVENTORIES; IMPROVEMENT OF THE UNDERSTANDING OF THE DYNAMIC MECHANISMS AND PROCESSES LEADING TO LONG RANGE TRANSPORT; POLLUTANT TRANSFORMATION AND POLLUTANT REMOVAL (WET/DRY DEPOSITION); THE MEASUREMENT OF HORIZONTAL AND VERTICAL SULPHUR DISTRIBUTION (MEASUREMENT AND ANALYSIS OF PARTICULATES AND PRECIPITATION CHEMISTRY); AND THE DEVELOPMENT AND REFINEMENT OF MESO SCALE MODELS.

AS A RESULT OF THESE AND OTHER STUDIES, A NUMBER OF IMPORTANT FINDINGS ON THE NATURE OF LONG RANGE TRANSPORT OF NITROGEN AND SULPHUR OXIDES (INCLUDING THEIR TRANSFORMATION PRODUCTS) IN EASTERN NORTH AMERICA CAN BE STATED. THESE FINDINGS INCLUDE:

* MARITIME TROPICAL AIR MASSES FROM THE GULF OF MEXICO THAT OCCUR IN THE LATE SUMMER HAVE THE GREATEST POTENTIAL FOR FORMATION AND TRANSPORT OF HIGH CONCENTRATIONS OF SULPHATE INTO THE NORTHEASTERN UNITED STATES AND INTO

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EASTERN CANADA. CONVECTIVE SHOWERS ARE ALSO TYPICAL OF THESE AIR MASSES WHICH CAN LEAD TO ACID PRECIPITATION.

* THE MECHANISMS OF THE CHEMICAL REACTIONS ASSOCIATED WITH ACID DEPOSITION ARE QUITE COMPLEX AND DEPEND ON A HOST OF VARIABLES. THEY RANGE FROM THE PHYSICAL PROPERTIES OF THE POLLUTANTS TO WEATHER CONDITIONS AND THE PRESENCE OF CATALYTIC OR INTERACTING AGENTS. EVEN THOUGH THESE CHEMICAL PROCESSES ARE NOT VERY WELL UNDERSTOOD, IT DOES APPEAR THAT LONG RANGE TRANSPORT OF SULPHUR COMPOUNDS CAN COVER 1000 TO 2000 KM OVER THREE TO FIVE DAYS.

* ACID PRECIPITATION HAS RECEIVED INTENSIVE STUDY IN SOUTHERN SCANDINAVIA. THIS RESEARCH HAS SHOWN THAT ACID RAIN IN NORWAY AND SWEDEN PRIMARILY RESULTS FROM LARGE SCALE TRANSPORT OF NITROGEN AND SULPHUR OXIDE EMISSIONS IN GREAT BRITAIN AND THE INDUSTRIAL REGIONS OF CONTINENTAL WESTERN EUROPE (EG. WEST GERMANY, BELGIUM, HOLLAND, FRANCE).

* AIR POLLUTION PROBLEMS ASSOCIATED WITH SULPHUR COMPOUNDS ARE OF A LARGE-REGIONAL NATURE IN EASTERN NORTH AMERICA, AFFECTING BOTH CANADA AND THE UNITED STATES. POLLUTION PROBLEMS ON THIS SCALE RESULT FROM THE ATMOSPHERIC TRANSPORT OF EMISSIONS OVER DISTANCES OF HUNDREDS TO THOUSANDS OF KILOMETRES DOWNWIND OF LARGE INDUSTRIAL

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regions. Frequently, control strategies such as the use of very tall stacks, through which increased emissions became allowable, contributed to the worsening of regional scale problems.

I will now describe how Ontario's studies have established that emissions in the Eastern United States, including the State of Indiana, constitute a major contribution to Ontario's Pollution Problems.

Ontario has air masses moving into it from all directions depending on the synoptic conditions. Some of these lead to the transboundary transport of pollutants contributing to the development of air pollution episodes in Ontario. An example of such an episode occurred during the period of February 19 to 21, 1979. The series of weather maps for these days (Figures 1 to 3) show a high pressure area located south of the Great Lakes on the 19th that moved eastward to off the Atlantic coast on the 21st. The southerly circulation back-of-the high carried with it sulphur dioxide and particulate matter including sulphates into Ontario. Ontario's Pollution Index, which is based on these pollutants, reached high levels where it was measured, exceeding 32 in Sarnia (max. 43), Hamilton (max. 34) and Toronto (max. 33). Industries in these locations were asked to curtail emissions to prevent the pollution from reaching health affecting levels, i.e. above 57.

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Using back trajectory analyses and the measurements of pollutants at rural locations near the boundary, Ontario's scientists estimated that as much as 50% of the pollution was transported into the Province from the United States. Back trajectory analysis is the name given to a procedure by which air parcels are followed backward in time to determine the origin and track that the air parcel has taken. The procedure is considered accurate in terms of direction of movement taken by the air parcel for a period as long as 48 hours. Figures 4,5 and 6 show the air parcel trajectories terminating at locations in Ontario at 1:00 a.m. on the 19th, 20th and 21st. These show that the air had passed across the highly industrialized midwestern states that have many coal fired power plants. This is not an isolated incident. During the period 1976 to 1980 there have been 15 such major incidents of high sulphates in Ontario resulting from a back-of-a-high pressure area southerly circulation.

Impacts of the transported pollutants are the result of their atmospheric deposition by various wet and dry means. Data from precipitation collectors operated in the Dorset area over almost a 3 year period, combined with back trajectory analyses, showed that about 75% of the precipitation events and moreover, approximately 80% of the wet acid deposition at this site, were associated with air masses arriving from the south and southwest. Comparatively, a small percentage of the loadings came from the north and northwest where major Ontario sources are located.

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WHILE BACK TRAJECTORY ANALYSIS CAN TELL US THE DIRECTION FROM WHICH THE AIR HAS ORIGINATED IT CANNOT QUANTIFY THE AMOUNT OR PERCENTAGE OF CONTRIBUTION THAT INDIVIDUAL SOURCES OR AGGREGATES OF SOURCES HAVE ON A RECEPTOR AREA. FOR SUCH AN ANALYSIS, ONTARIO UTILIZES COMPUTER MODELS WHICH SIMULATE THE ATMOSPHERE AND THE BEHAVIOUR OF POLLUTANTS EMITTED INTO IT.

UNTIL A FEW YEARS AGO, ENVIRONMENTALISTS WERE PRIMARILY CONCERNED WITH AIR QUALITY IN THE VICINITY OF A POLLUTANT SOURCE. CONCENTRATIONS WERE CONSIDERED HIGH IF THEY WERE ABOVE LEVELS DETERMINED TO BE HARMFUL TO PLANTS AND HUMAN HEALTH. USING THIS CRITERION, EVEN LARGE POLLUTANT SOURCES COULD BE CONSIDERED TO HAVE LITTLE EFFECT BEYOND DISTANCES OF THE ORDER OF TENS OF KILOMETRES FROM THE SOURCE. THIS WAY OF LOOKING AT POLLUTION IGNORED THE EFFECTS OF THE LARGE FRACTION OF THE EMISSIONS WHICH LEFT THIS REGION OF "LOCAL" AIR QUALITY EFFECTS.

IT IS TO BE NOTED THAT APPLYING THE CONVENTIONAL SHORT RANGE MODELS RECOMMENDED BY EPA, ALL THE POLLUTANTS ESCAPE TO GREATER DISTANCES, ALTHOUGH IN SMALL CONCENTRATIONS. IF WE APPLY DRY AND WET DEPOSITION TO THE PLUME, THEN APPROXIMATELY 30 - 90% OF THE POLLUTANTS WOULD ESCAPE TO GREATER DISTANCES DEPENDING ON STACK HEIGHT. THIS IS ASSUMING THAT 10% OF THE TIME THE PLUME ENCOUNTERS PRECIPITATION AT THE RELEASE POINT.

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It is only recently that knowledge of the cumulative effect of small concentrations from a large number of sources has become commonplace. Secondary pollutants from several sources can be high at distances of hundreds of kilometres from the source region. Furthermore, the occurrence of acid rain has forced us to redefine the meaning of "high" as applied to local air quality.

Analysis of meteorology during high TSP episodes has shown the role of long-range transport. Mathematical modelling has also indicated the extent of pollution caused by long range transport. These models also determine the source-receptor relationships and develop emission control strategies.

In response to these evolving needs, Ontario has developed an internationally respected long range transport model - which calculates the contribution of sulphur deposition from the emitting sources. These have been computed on a percentage basis for receptor areas in both Canada and the United States which are sensitive to acidic deposition. Ontario has used the results of this model in making the decisions for the control of Ontario's major SO_2 emitters and for the determination of the impact of sources that are located in the Eastern United States and neighbouring Provinces. Also, the model has been used as a guideline to predict what will happen if sources in the midwestern United States have their State Implementation Plan (SIP) limits relaxed, a subject of the recent EPA Section 126

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HEARINGS HELD IN WASHINGTON. TABLE 1 SHOWS THE SULPHUR DIOXIDE EMISSIONS BY THE 20 UTILITIES CITED BY NEW YORK THAT ARE SEEKING RELAXATION OF EMISSION LIMITS. THE RESULTING IMPACT IF THE EMISSION LIMITS WERE ENFORCED AS WELL AS THE IMPACT SHOULD A RELAXATION BE ALLOWED ARE SHOWN IN TABLE 2.

EFFECTS OF LRTAP

DOCUMENTED EVIDENCE ON THE EFFECTS OF LONG-RANGE TRANSPORT OF AIR POLLUTANTS, SPECIFICALLY ACIDIC DEPOSITION, IS CURRENTLY LIMITED TO THE AQUATIC ENVIRONMENT; HOWEVER, INTENSIVE STUDIES ARE NOW UNDERWAY TO DOCUMENT THE EFFECTS ON THE TERRESTRIAL ENVIRONMENT, MATERIALS AND PROPERTY, AS WELL AS HUMAN HEALTH.

IN THIS SECTION, I WILL BRIEFLY OUTLINE FOR YOU THE RESULTS OF SOME OF THE ONTARIO MINISTRY OF THE ENVIRONMENT STUDIES ON THE AQUATIC EFFECTS OF LRTAP. EVEN THOUGH THESE RESULTS PERTAIN TO ONTARIO, SIMILAR RESULTS ARE AVAILABLE FROM STUDIES IN THE NORTHEASTERN UNITED STATES AND SCANDINAVIA.

I WILL VERY BRIEFLY TOUCH ON SOME VERY IMPORTANT OBSERVATIONS REGARDING WATER QUALITY.

IN MOST PARTS OF THE PRECAMBRIAN SHIELD, THE ACIDS ASSOCIATED WITH THE ATMOSPHERIC DEPOSITION OF SULPHATE ARE NEUTRALIZED IN THE WATERSHED DURING MOST OF THE YEAR. RETENTION (NEUTRALIZATION) OF HYDROGEN ION DEPOSITION HAS BEEN MEASURED AT 88% AND 98% ON AN ANNUAL BASIS AT KENORA AND DORSET RESPECTIVELY.[1,2]

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HOWEVER, IN SPITE OF THE LOW TOTAL DISCHARGE OF ACID TO THE LAKES, MANY DETRIMENTAL WATER QUALITY EFFECTS ARE BEING OBSERVED. THE HYDROGEN IONS (ACID) STORED IN THE SNOW ARE RELEASED IN A SHORT TIME DURING RUNOFF IN THE SPRING THAW AND MOST OF THE TOTAL ANNUAL ACID INPUT OCCURS DURING THE SPRING MELT. THE LARGE VOLUME OF WATER, COUPLED WITH LESS CHANCE FOR INTERACTION WITH THE SOIL, WHICH MAY BE FROZEN, RESULTS IN SHOCK LOADINGS OF ACID TO STREAMS AND TO THE SURFACE WATERS OF LAKES.

JEFFRIES[3] COMPARED PH VALUES OF A SERIES OF SMALL STREAMS AND LAKE OUTFLOWS AT DORSET BEFORE AND DURING SPRING RUNOFF, (SEE TABLE 3). AT THE VERY MINIMUM, THE SURFACE WATERS OF THE ENTIRE LAKES WERE ACIDIFIED DURING THIS PERIOD OF TIME. THE LOWEST PH VALUES, 4.8 - 5.0, OBSERVED IN LAKE OUTFLOWS, ARE WITHIN A RANGE CAPABLE OF CAUSING DAMAGE TO AQUATIC LIFE, PARTICULARLY TO FISH.[4] AS MUCH AS 75% OF THE MEASURED YEARLY ACID DISCHARGE FROM THE WATERSHEDS RAN OFF IN APRIL. FIGURE 7 SHOWS A TYPICAL HYDROGRAPH FOR ONE OF THESE STREAMS, EMPHASIZING THE HIGH SPRING WATER FLOW, HIGH ACID DISCHARGE, AND LOW PH VALUES.

THERE ARE ABOUT 30 STREAMS UNDER STUDY IN THE DORSET CALIBRATED WATERSHEDS AND SOME HAVE RESULTS FOR A PERIOD OF FIVE YEARS. THE RESULTS FOR THE HARP LAKE WATERSHED PRESENTED HERE ARE TYPICAL OF THE FULL SET OF OBSERVATIONS AND IT CAN BE CONCLUDED THAT ATMOSPHERIC ACID LOADINGS ARE CAUSING PERIODIC WATER QUALITY CHANGES. THE STUDY LAKES ALL HAVE LOW ALKALINITES AND ARE REPRESENTATIVE OF THOUSANDS OF LAKES IN THE PRECAMBRIAN AREA.

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The distribution of alkalinity data for a number of lakes throughout the province is shown on Table 4.

The number of lakes sampled in each area to date is small in comparison to the total lakes in these areas, but based on this data, it is becoming clear that a very high percentage of the lakes in the entire Precambrian Shield fall in the extremely or moderately sensitive categories.

It is important to realize that the alkalinity values cover a wide range of values. A certain number of lakes will have the capacity to neutralize a particular acid input, and those with less neutralizing capacity will be damaged. The greater the acid input, the greater the number of lakes affected and the greater the degree of damage likely to be caused in the affected lakes. Therefore, we believe that all increases in acid loadings will be detrimental, while all reductions will be beneficial to some degree.

Fish population damage is a major concern as it represents loss to the sport fishing industry and serious disturbance of the biological food chain since many birds and mammals depend on fish for food. Complete loss of fish tends to be regarded as the definition of a "dead" lake.

Some of the study lakes at Dorset have been subjected to intensive fish population measurements and several observations are relevant.

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Plastic Lake has experienced fish kills during snow melt when the pH has been as low as 4.7. Fish caging experiments in the spring of 1981 have confirmed the toxic conditions, particularly near the inlet streams, where the test fish all died within two days. The pH at the inlet location was as low as 4.0.[5] There was no mortality in control streams during the same period where the pH was never measured at less than 6.1. Similar effects have been observed in lakes in Norway and Sweden.[6,7]

White suckers are an important "test species", since they are not subject to much direct fishing pressure and therefore changes in population are mainly due to environmental effects.

In one study lake, a distinct shift toward a younger average age of white suckers was observed. This is believed to be a characteristic response to lake acidification. Similar effects have been observed in Norway.[8]

Yet another study lake has a year class of this species missing. This is also a characteristic of lakes subject to acidification damage.

These observations provide strong evidence that the fisheries are beginning to suffer under the present acid loading conditions. It is reasonable to assume that similar changes are taking place in the many thousands of lakes with

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SIMILAR ALKALINITIES WHICH ARE LIKELY EXPERIENCING SIMILAR WATER QUALITY EFFECTS.

ANOTHER WAY IN WHICH THE DEPOSITION OF ACID SUBSTANCES CAN HAVE A DETRIMENTAL EFFECT ON THE ENVIRONMENT IS THAT IT INCREASES THE LEACHING RATE OF MATERIAL FROM THE WATERSHED. FOR EXAMPLE, ALUMINUM WHICH IS A MAJOR CONSTITUENT OF THE BEDROCK MATERIAL IN THE PRECAMBRIAN AREA, TENDS TO BE DISSOLVED BY ACIDIC RUNOFF.

SCHEIDER[1] REPORTED AN AVERAGE TOTAL ALUMINUM CONCENTRATION OF 49 µG/L FOR THE STUDY LAKES AT DORSET. CONCENTRATIONS IN STREAMS ARE TYPICALLY UP TO 200 - 300 µG/L WITH SOME MEASUREMENTS EXCEEDING 500 µG/L, PARTICULARLY IN THE SPRING RUNOFF (SCHEIDER, PERS. COMM.).

LABORATORY EXPERIMENTS HAVE SHOWN THAT SURVIVAL OF BROOK TROUT WAS REDUCED TO LESS THAN 50% AFTER 14 DAYS AT ALUMINUM CONCENTRATIONS OF 420 AND 480 µG/L AT PH VALUES OF 5.2 AND 4.4 RESPECTIVELY.[9]

IT APPEARS THAT THE PH AND ALUMINUM CONCENTRATIONS BEING OBSERVED IN THE DORSET STUDY LAKES DURING SPRING SNOW MELT FALL WITHIN THE RANGES WHICH LABORATORY EXPERIMENTS HAVE SHOWN TO BE LETHAL TO FISH. IT IS QUITE POSSIBLE THAT THE OBSERVED FISH KILLS AND APPARENTLY ALTERED AGE DISTRIBUTION OF WHITE SUCKERS ARE DUE TO THE COMBINATION OF PH AND ALUMINUM.

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THE ABOVE INFORMATION DEMONSTRATES THE SERIOUSNESS OF THIS PROBLEM, SPECIFICALLY IN THE AQUATIC ENVIRONMENT. HOWEVER, THE POSSIBLE EFFECTS ON OUR TERRESTRIAL ECOSYSTEM (FORESTS, SOILS, AGRICULTURAL CROPS), PROPERTY AND MATERIALS AS WELL AS HUMAN HEALTH WILL ONLY SERVE TO INCREASE THE SEVERITY OF THE PROBLEM.

CONCLUDING REMARKS

ONTARIO BELIEVES THAT THE RELAXATION OF THE SIP EMISSION LIMITS FOR SULPHUR DIOXIDE WILL RESULT IN A SERIOUS DEGRADATION OF ITS ENVIRONMENT. TABLE 5 SHOWS THE TREND IN SO_2 EMISSIONS IN ONTARIO FOR THE PERIOD OF 1972 TO 1990, A DROP IN EMISSIONS OF MORE THAN 50%. THE EFFECTS OF THIS WILL BE NEGATED SHOULD THE UNITED STATES ALLOW ITS SOURCES TO INCREASE THEIR EMISSIONS. WHILE FURTHER RESEARCH WILL BE HELPFUL, THERE IS NOW CLEAR EVIDENCE OF SIGNIFICANT TRANSPORT OF DAMAGING POLLUTION FROM THE MIDWESTERN STATES TO RECEPTOR AREAS IN EASTERN CANADA AND NORTHEASTERN UNITED STATES. TO ALLEVIATE THIS, THE PROVINCE OF ONTARIO URGES THE GOVERNMENTS OF MIDWESTERN STATES AND THE UNITED STATES TO ACT NOW, THAT IS, TO DISALLOW ANY INCREASE IN EMISSIONS FROM SOURCES WITHIN THEIR JURISDICTIONS.

IT IS WORTH NOTING THAT THE RECENT NATIONAL ACADEMY OF SCIENCE REPORT ENTITLED "ATMOSPHERE - BIOSPHERE INTERACTIONS: TOWARDS A BETTER UNDERSTANDING OF THE ECOLOGICAL CONSEQUENCES OF FOSSIL - FUEL COMBUSTION", VERY STRONGLY SUPPORTS ONTARIO'S POSITION.

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THE FOLLOWING QUOTE SUCCINCTLY SUMMARIZES THE ACADEMY'S POSITION ON THE ACIDIC DEPOSITION PHENOMENON:

"ACID DEPOSITION, DUE TO THE FURTHER OXIDATION OF SULPHUR AND NITROGEN OXIDES RELEASED TO THE ATMOSPHERE BY ANTHROPOGENIC SOURCES, IS CAUSING WIDESPREAD DAMAGE TO AQUATIC ECOSYSTEMS, INCLUDING LOSS OF BICARBONATE, INCREASED ACIDITY, AND HIGHER CONCENTRATIONS OF TOXIC METALS. AS A RESULT, SEVERAL IMPORTANT SPECIES OF FISH AND INVERTEBRATES HAVE BEEN ELIMINATED OVER SUBSTANTIAL PARTS OF THEIR NATURAL RANGES.

EFFECTS ON TERRESTRIAL ECOSYSTEMS ARE LESS PRONOUNCED. INCREASED LEACHING OF BOTH NUTRIENTS AND TOXIC ELEMENTS IS EVIDENT IN POORLY BUFFERED SOILS SENSITIVE TO ACIDIFICATION. THERE IS SOME EVIDENCE FOR DAMAGE TO CROP PLANTS, AND MANY SOIL MICROBIAL PROCESSES ARE NEGATIVELY AFFECTED AT LOW PH. TREES APPEAR TO BE SLIGHTLY STIMULATED BY ACID PRECIPITATION, ALTHOUGH THIS EFFECT IS EXPECTED TO BE SHORT-LIVED, BECAUSE OF INCREASED LEACHING OF CATIONIC NUTRIENTS AND THE BUILDUP OF TOXIC CONCENTRATIONS OF METALS IN SOIL WATER.

OF THE OPTIONS PRESENTLY AVAILABLE ONLY THE CONTROL OF EMISSIONS OF SULPHUR AND NITROGEN OXIDES CAN SIGNIFICANTLY REDUCE THE RATE OF DETERIORATION OF SENSITIVE FRESHWATER ECOSYSTEMS. IT IS DESIRABLE TO HAVE PRECIPITATION WITH PH VALUES NO LOWER THAN 4.6 TO 4.7 THROUGHOUT SUCH AREAS, THE

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VALUE AT WHICH RATES OF DEGRADATION ARE DETECTABLE BY CURRENT SURVEY METHODS, AS MENTIONED ABOVE. IN THE MOST SERIOUSLY AFFECTED AREAS (AVERAGE PRECIPITATION PH OF 4.1 TO 4.2), THIS WOULD MEAN A REDUCTION OF 50 PERCENT IN DEPOSITED HYDROGEN IONS. CONTROL OF SO_2 FROM NEW ELECTRICAL GENERATING PLANTS ALONE WOULD BE INSUFFICIENT TO ACCOMPLISH THIS, AND THUS RESTRICTIONS ON OLDER PLANTS MUST BE CONSIDERED. FURTHERMORE, THERE ARE NO PROPOSED RESTRICTIONS ON THE EMISSION OF NITROGEN OXIDES, AND THE AMOUNTS OF THESE SUBSTANCES EMITTED ARE EXPECTED TO CONTINUE TO INCREASE.

THE CONTROL OF EMISSIONS OF SULPHUR AND NITROGEN OXIDES FROM FOSSIL FUELS IS NECESSARY TO HALT THE ACIDIFICATION OF SENSITIVE AQUATIC ECOSYSTEMS."

IN SUMMARY, THE ACADEMY CONCLUDED:

1) "THAT CONTINUED EMISSIONS OF SULPHUR AND NITROGEN OXIDES AT CURRENT OR ACCELERATED RATES, IN THE FACE OF CLEAR EVIDENCE OF SERIOUS HAZARD TO HUMAN HEALTH AND TO THE BIOSPHERE, WILL BE EXTREMELY RISKY FROM A LONG TERM ECONOMIC STAND POINT AS WELL AS FROM THE STAND POINT OF BIOSPHERE PROTECTION;"

2) "THAT BASED ON THE EVIDENCE EXAMINED THE PICTURE IS DISTURBING ENOUGH TO MERIT PROMPT TIGHTENING OF RESTRICTIONS ON ATMOSPHERIC EMISSIONS FROM FOSSIL FUELS AND OTHER LARGE SOURCES."

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THE PROVINCE OF ONTARIO IS IN COMPLETE ACCORD WITH THE ACADEMY'S CONCLUSIONS AND RECOMMENDATIONS.

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Table 1 U.S. Coal-Burning Power Plants Proposing an Increase in their SO_2 Emission Limits

NOTE: All figures are in thousands of metric tons.

STATE Power Plant	Amount Allowable Under 1979 Regulation	Proposed Increase In Emissions Above Regulation	Proposed Total Emissions	Estimated 1979 SO_2 Emissions
ILLINOIS				
1) Baldwin	228.7	54.4	283.1	257.9
INDIANA				
2) Clifty Creek	46.2*	243.3	289.5**	263.7
3) Tanners Creek	26.1	116.6	142.7	85.2
4) Michigan City	17.0	84.1	101.1	62.4
5) Culley	12.5	50.4	62.9	61.3
6) Bailly	13.9	46.6	60.5	58.0
7) Stout, Elmer W.	17.6	72.2	89.8	44.2
8) Warrick	4.3	111.7	116.0	20.2
9) Mitchell, Dean H.	13.6	62.2	75.8	19.2
MICHIGAN				
10) Cobb	40.3	20.2	60.5	69.3
11) Campbell	39.2	19.5	58.7	57.0
OHIO				
12) Muskingham	235.0	150.5	385.5	340.2
13) Cardinal	214.1	68.6	282.7	140.8
14) Beckjord	136.0	9.2	145.2	99.7
15) Poston	16.3	16.3	32.6	29.1
16) Bayshore	19.3	16.2	35.5	23.7
17) Avon Lake	26.0	111.4	137.4	98.0
18) Eastlake	36.5	131.4	167.9	137.4
TENNESEE				
19) Kingston	51.0	90.2	141.2	87.2
WEST VIRGINIA				
20) Kammer	63.6	157.3	220.9	136.8
TOTAL	1257.2	1632.3	2889.5	2091.3

* Based on S.I.P. of 1.2 lb. SO_2/M Btu.

** Based on S.I.P. of 7.52 lb. SO_2/M Btu.

Table 2 Contributions of Wet Sulphur Deposition From 20 U.S. Power Plants Under Various Emission Cases to Environmentally Sensitive Areas in Canada and the U.S.

Note: Each column presents data connected with plants' emissions, as described. In all cases, the data are expressed as wet deposition percentages, with the normalizing factor being the total wet deposition occurring in 1979 due to actual emissions from all sources.

Note: Model predictions have been verified to be accurate within a factor of 2 with 60% of the estimates being within 35% of expected values. The range of values given in the text is derived from the figures below.

Sensitive Region	Amount due to actual 1979 emissions	Decrease occurring if 1979 actual emissions were reduced to 1979 SIP maximums.	Increase occurring if emissions rise from 1979 SIP maximum to proposed maximum.	Increase occurring if emissions rise from actual 1979 levels to proposed new limits.	Amount due to emissions if they are held at 1979 SIP limits (Column 1 minus Column 2)	Amount due to emissions if they rise to proposed new limits (Column 1 plus Column 4)
Muskoka-Haliburton, Ontario	4.5	2.0	3.4	1.4	2.5	5.9
Algoma, Ont.	3.0	1.3	2.2	0.9	1.7	3.9
Lakehead, Ont.	1.9	0.8	1.4	0.7	1.1	2.6
Val D'or, Que.	2.7	1.1	2.0	0.8	1.6	3.5
Adirondacks, N.Y.	5.5	2.3	4.3	1.9	3.2	7.4
West Pennsylvania	11.4	3.4	8.5	5.0	8.0	16.5

TABLE 3

pH OF STREAMS IN MUSKOKA-HALIBURTON, ONTARIO, CANADA:
STREAM pH IS GIVEN PRIOR TO SPRING RUNOFF (MID-MARCH 1978)
AND AT MAXIMUM RUNOFF (MID-APRIL 1978)

Annual Average Alkalinity data from Scheider (Pers. Comm)

Watershed	Annual Average Alkalinity μeq/l	Stream Number	pH	
			Mid-March	Mid-April
Harp Lake	96	3	6.1	5.1
		3A	6.0	5.6
		5	5.9	4.8
		6	6.2	5.3
		6A	5.4	5.0
		Outflow	6.3	5.0
Dickie Lake	55	5	4.6	4.3
		6	4.6	4.4
		11	4.9	4.1
		Outflow	5.6	4.9
Chub Lake	61	1	5.8	5.1
		2	5.2	4.7
		Outflow	5.5	4.8
Red Chalk Lake	92	1	6.1	5.6
		2	4.5	4.3
		3	6.0	5.5
		4	6.2	5.5
		Outflow	6.1	5.9

Partial Table From: Jeffries et al., 1979

TABLE 4 SUMMARY OF THE PERCENTAGE OF LAKES IN EACH ALKALINITY CLASS BY COUNTY OR DISTRICT

	Percentage of Total No. of Lakes in each Alkalinity Class					
County or District	Acidified (≤ 0 μeq/l)	Extreme Sensitivity (> 0 to 39.9 μeq/l)	Moderate Sensitivity (40 to 199 μeq/l)	Low Sensitivity (200 to 499 μeq/l)	Not Sensitive (≥ 500 μeq/l)	Total No. of Lakes Surveyed In County/ District
Algoma District	5	11	30	28	26	163
Bruce Co.					100	7
Cochrane Dist.		7		11	82	27
Durham Co.					100	1
Frontenac Co.				6	94	64
Grey Co.					100	3
Haliburton Co.		24	39	22	15	112
Hastings Co.			21	11	68	63
Huron Co.					100	1
Kenora Dist.			14	25	61	88
Lanark Co.					100	15
Leeds Co.					100	24
Lennox & & Addington Co.			36	12	52	25
Manitoulin Dist.	52	29	3	3	13	31
Middlesex Co.					100	1
Muskoka Dist.	1	30	61	2	6	115

...continued/

TABLE 4 SUMMARY OF THE PERCENTAGE OF LAKES IN EACH ALKALINITY CLASS BY COUNTY OR DISTRICT

County or District	Percentage of Total No. of Lakes in each Alkalinity Class					Total No. of Lakes Surveyed In County/ District
	Acidified (≤ 0 μeq/l)	Extreme Sensitivity (> 0 to 39.9 μeq/l)	Moderate Sensitivity (40 to 199 μeq/l)	Low Sensitivity (200 to 499 μeq/l)	Not Sensitive (≥ 500 μeq/l)	
Nipissing Dist.		9	75	13	3	75
Northumberland Co.					100	1
Ontario Co.					100	5
Parry Sound Dist.	5	20	64	10	1	107
Peel Co.					100	1
Peterborough Co.		4	16	6	74	49
Prince Edward Co.					100	3
Rainy River Dist.		3	64	19	14	99
Renfrew Co.			8	32	60	50
Simcoe Co.					100	7
Stormont Co.					100	1
Sudbury Dist.	24	29	23	12	12	210
Thunder Bay Dist.	1	2	25	27	45	136
Timiskaming Dist.	13		7	27	53	30
Victoria Co.					100	11
York Co.					100	2
						1,527

TABLE 5 TRENDS AND PROJECTIONS OF SULPHUR DIOXIDE EMISSIONS IN ONTARIO (IN METRIC TONS)

YEAR	SO_2 EMISSIONS	NOTES
1972	2,870,000	
1973	2,220,000	
1974	2,300,000	
1975	2,230,000	
1976	2,070,000	
1977	2,210,000	
1978*	1,557,000	*INCO STRIKE YEAR
1979*	1,325,000	*INCO STRIKE YEAR
1980	1,690,000	
1982-83	1,673,000	Assume INCO is at 1950 tons/day, or 646,000 tonnes/yr, and assume Ontario Hydro is at 582,000 tonnes (peak)
1985	1,480,000	Assume Ontario Hydro is at 390,000 tonnes and assume INCO is at 646,000 tonnes
1990	1,350,000	Assume Ontario Hydro is at 260,000 tonnnes and assume INCO is at 646,000 tonnes

June 1981

Ontario Ministry of Environment
Air Resources Branch

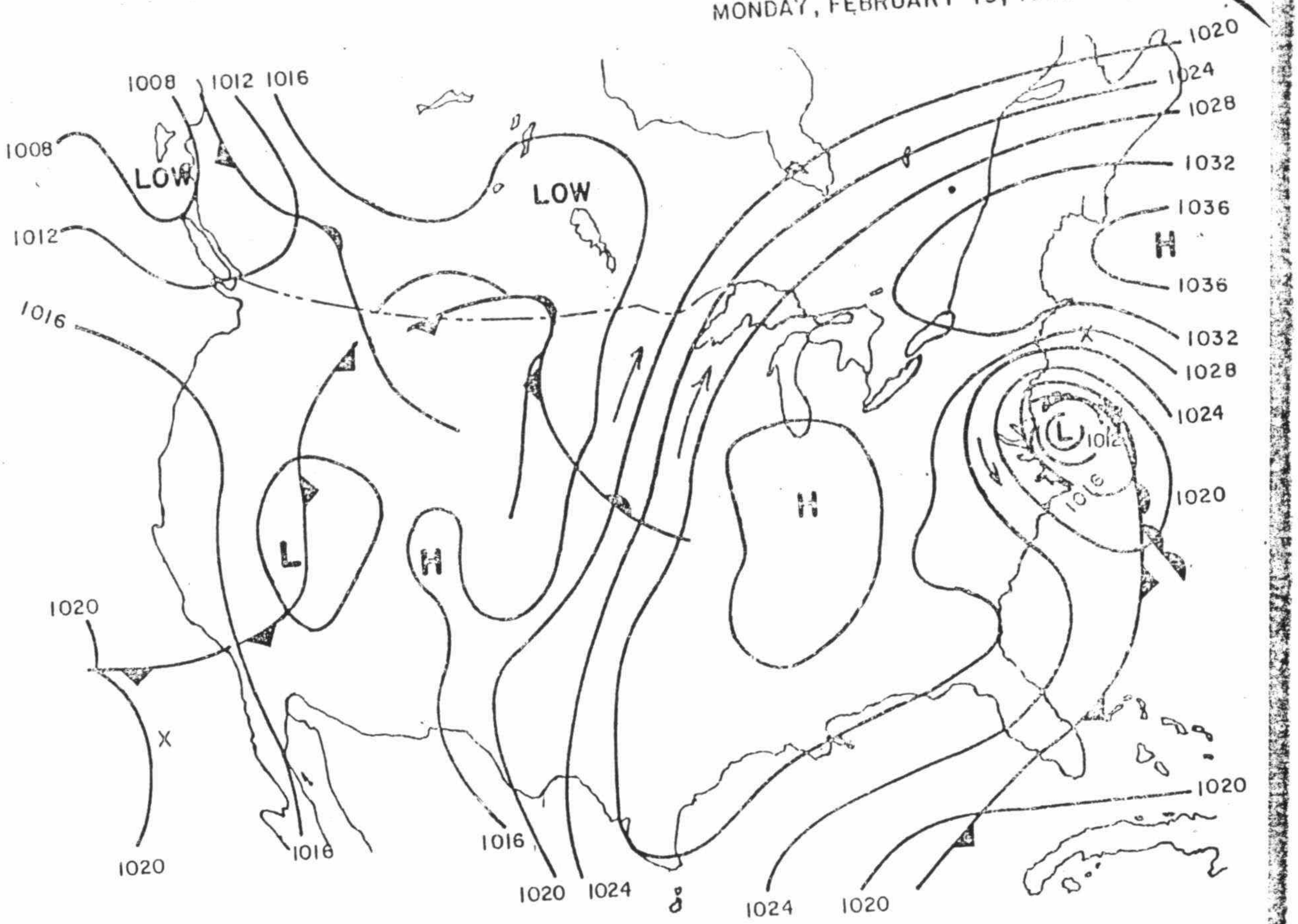
MONDAY, FEBRUARY 19, 1979
1008
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Figure #1

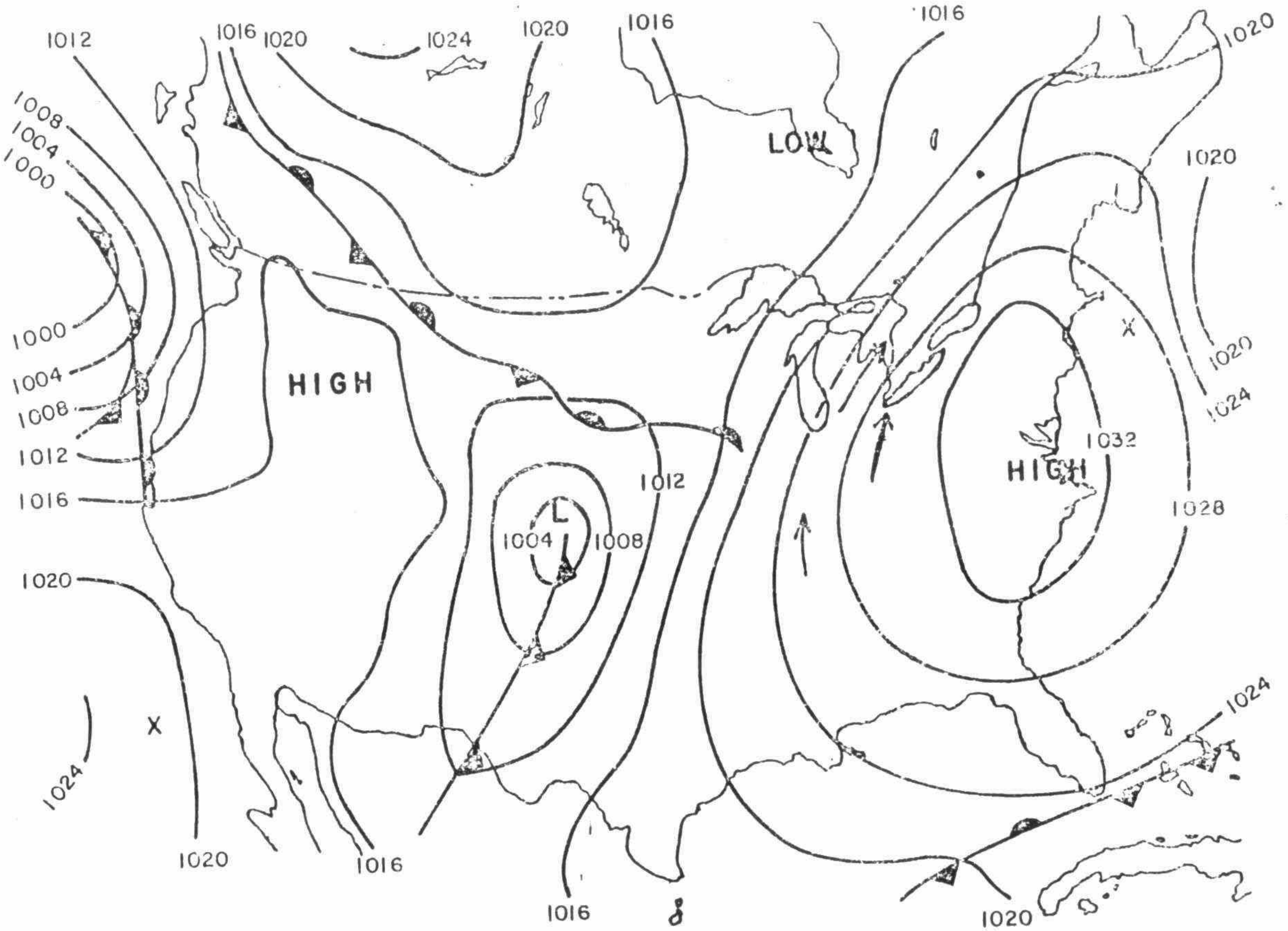
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Figure #2

WEDNESDAY, FEBRUARY 21, 1979

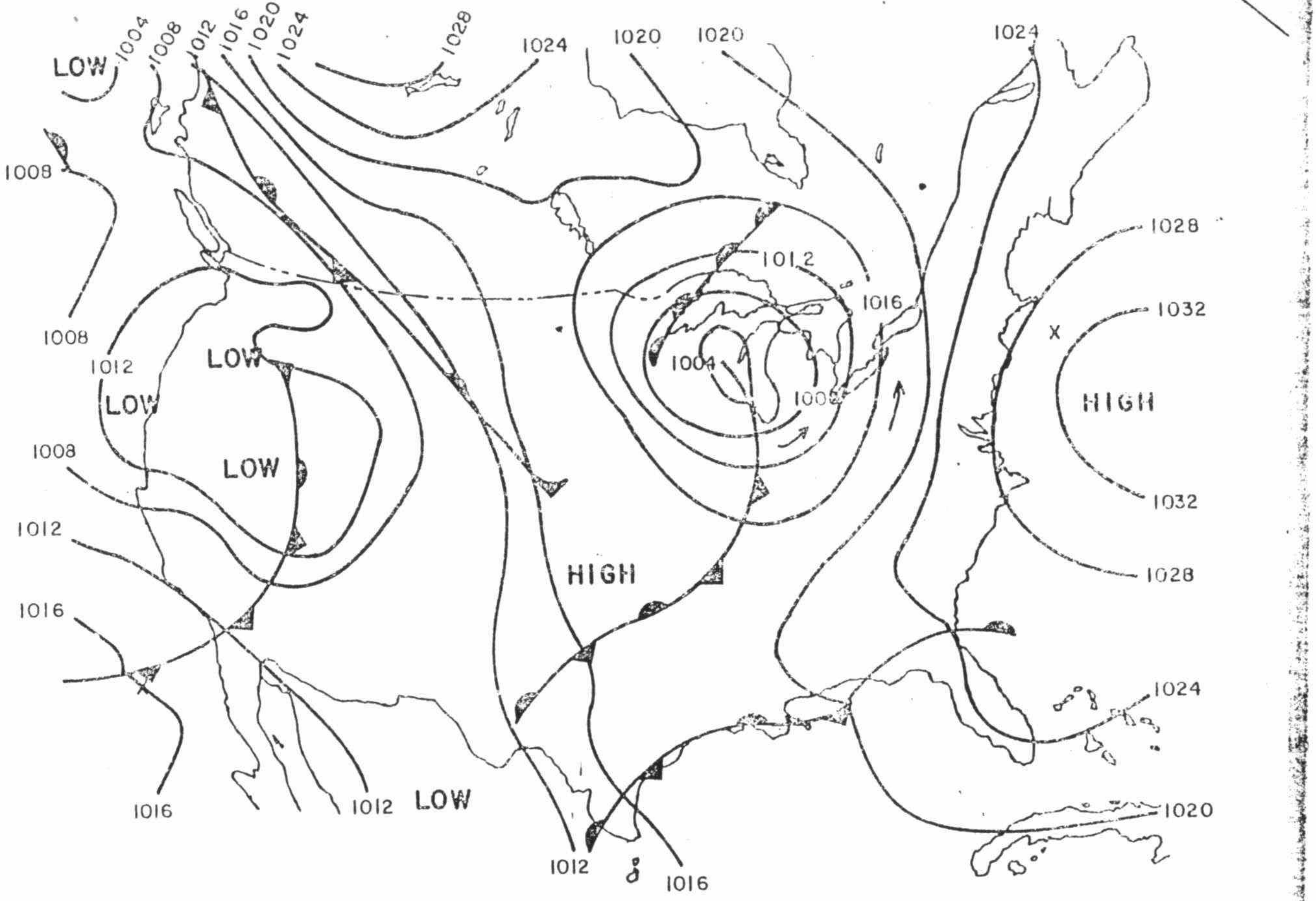
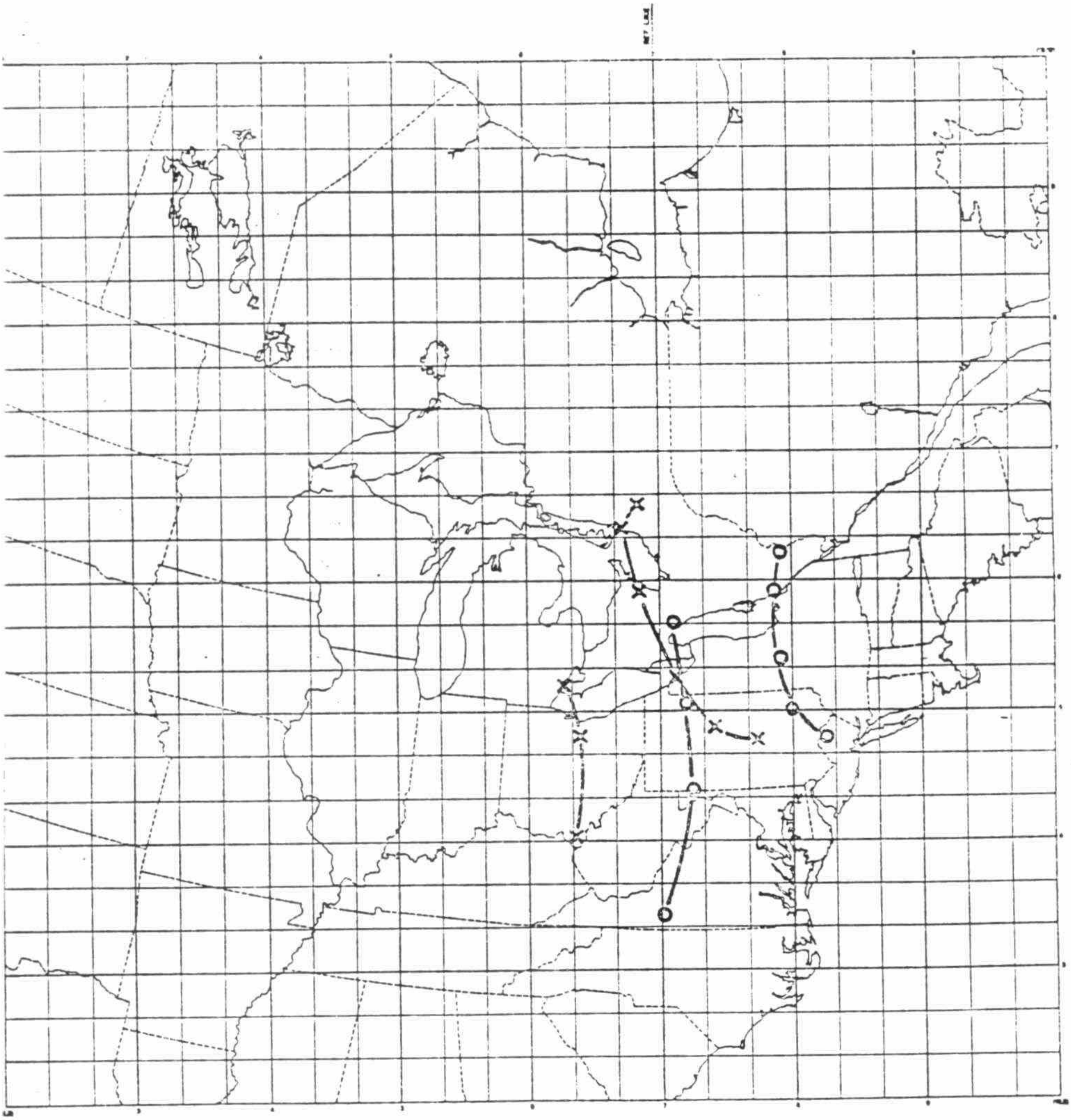
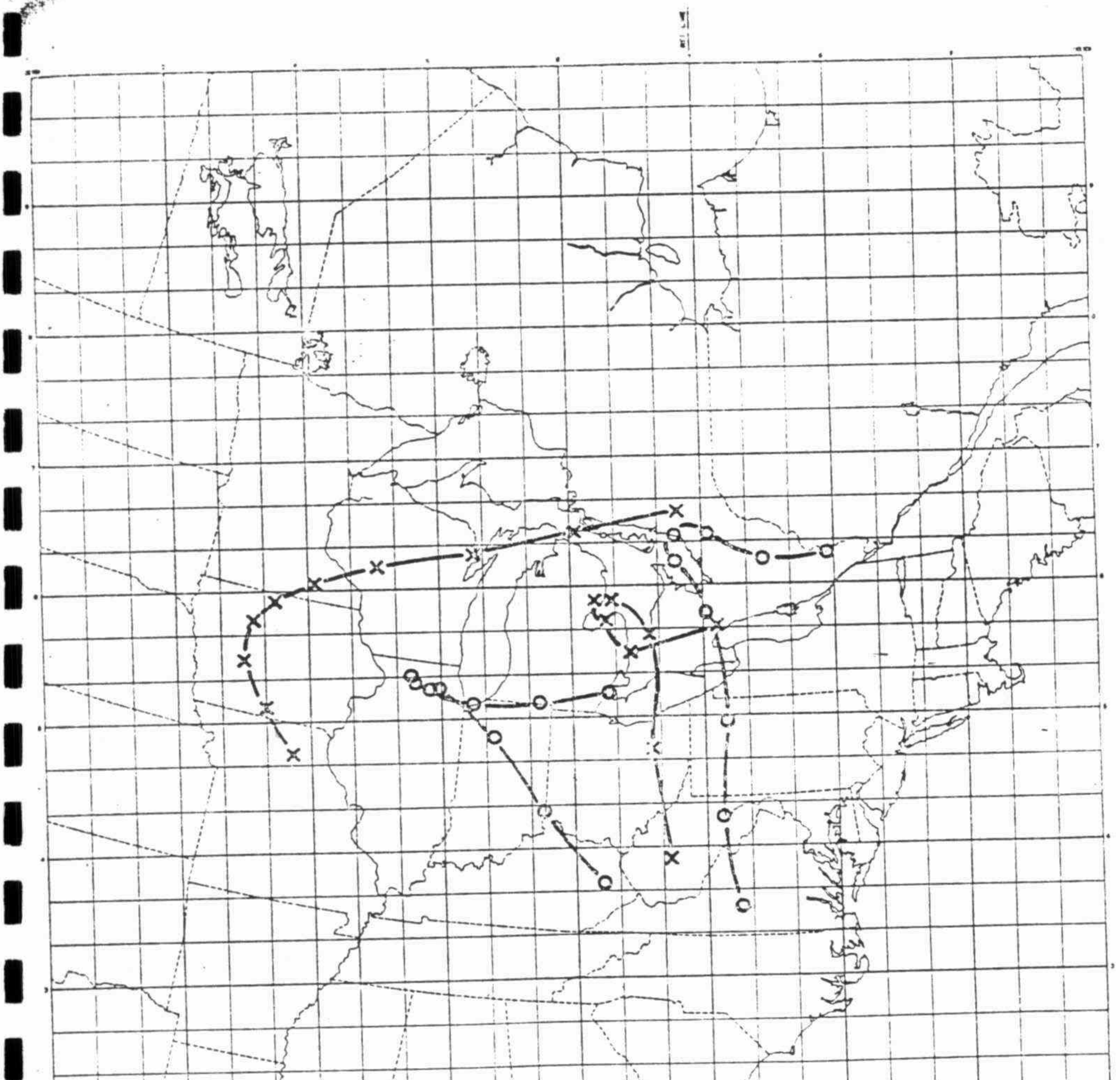


Figure #3



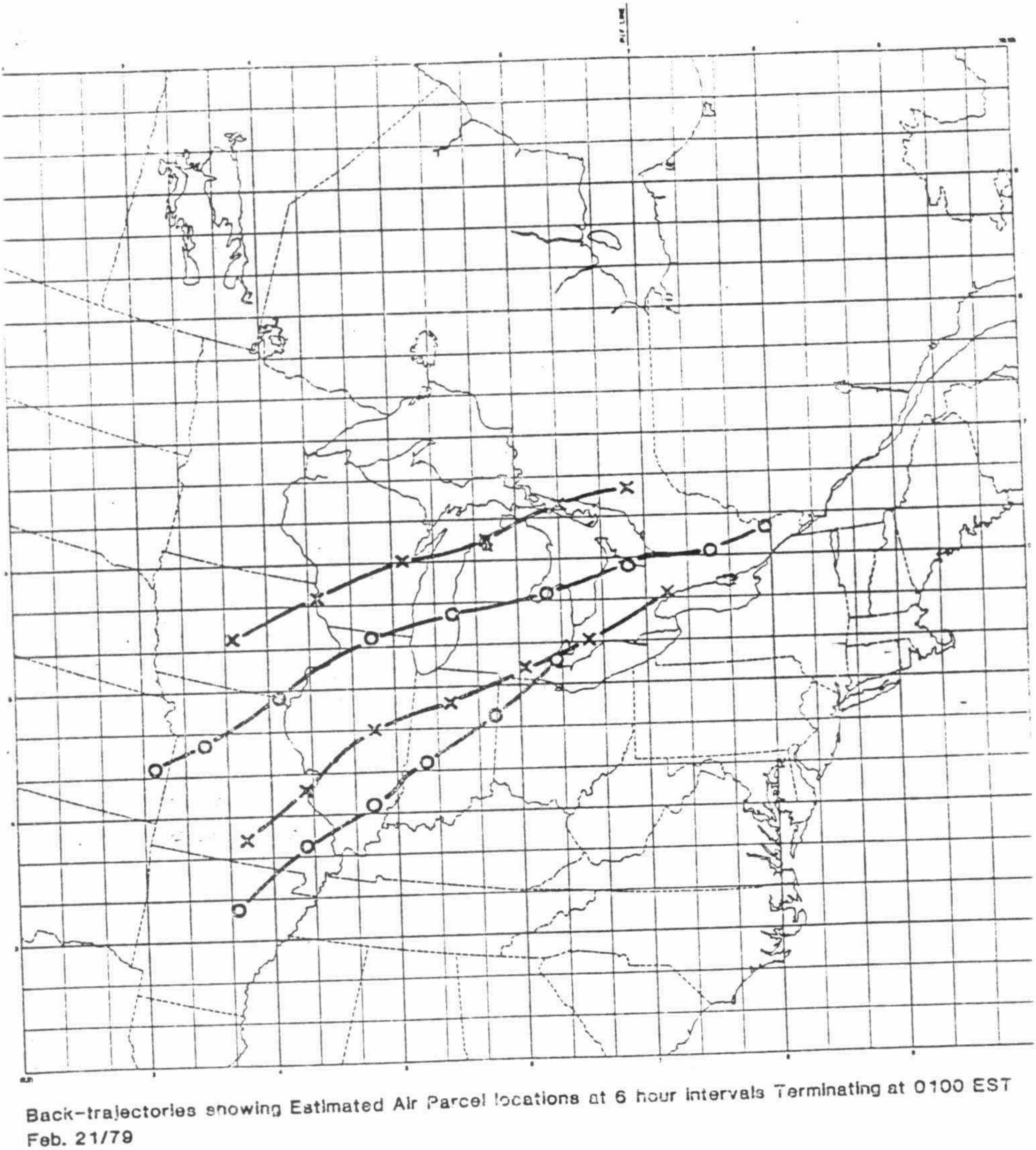
Back-trajectories showing Estimated Air Parcel locations at 6 hour intervals Terminating at 0100 EST Feb. 19/79

Figure #4



Back-trajectories showing Estimated Air Parcel locations at 6 hour intervals Terminating at 0100 EST Feb. 20/79

Figure #5



Back-trajectories showing Estimated Air Parcel locations at 6 hour intervals Terminating at 0100 EST Feb. 21/79

Figure #6

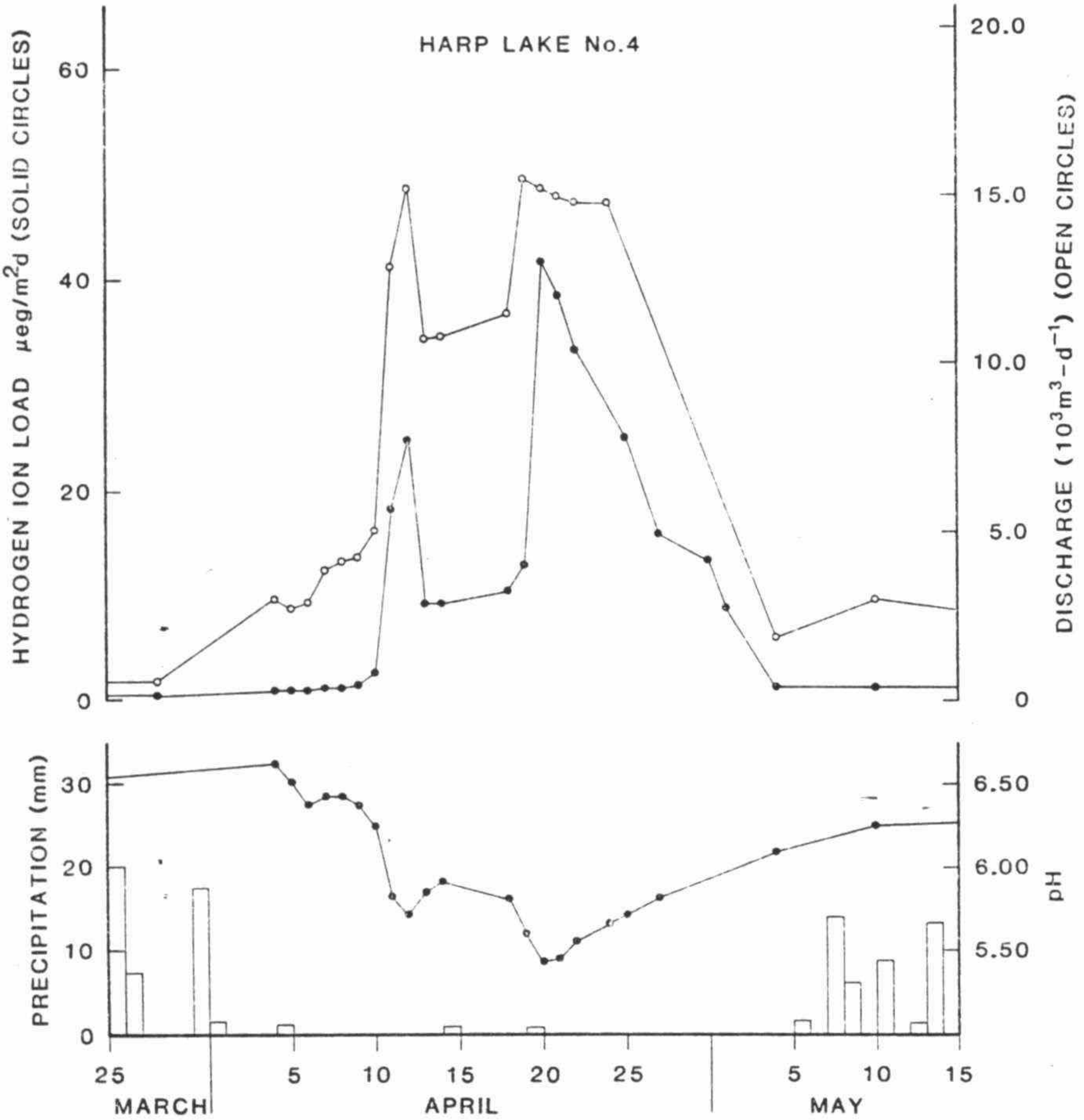


Figure 7 "Spring pH Depression" of a Stream
Graph illustrating "spring pH depression" in one of the six inflowing streams to Harp Lake, a study lake in Muskoka. As the spring runoff increases the amount of water, the acidic melted snow causes the stream pH to drop, producing severe chemical "shock" effects on aquatic life.

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Presentation to the Air Pollution
Control Board of the state of
Indiana in opposition to the
Indiana - Kentucky electric
78273